From Factory to Future: Designing a Better Environment For Learners K-6

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Abstract

This paper examines the critical factors facing educational spatial design in today's knowledge economy. The majority of learning spaces today are designed for 19th century learning, not taking into consideration the advancements in pedagogy, technology and a new economy. It is no longer enough to design educational facilities for durability and longevity of the physical building alone; there are many other considerations that must come into play.

The outcome of this research is an easy to use on-line reference tool for teachers, enabling them to take control of their classroom design, using established criteria, their own requirements and in supporting their pedagogies and learning styles. As a result, students will have a positive and motivating in-class experience in a supportive, intentional environment.

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Dedication

To David, for his support, patience, encouragement, and for picking up the slack.

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1. INTRODUCTION

> *"There's a dark little joke exchanged by educators with a dissident streak: Rip Van Winkle awakens in the 21st century after a hundred-year snooze and is, of course, utterly bewildered by what he sees. Men and women dash about, talking to small metal devices pinned to their ears. Young people sit at home on sofas, moving miniature athletes around on electronic screens. Older folk defy death and disability with metronomes in their chests and with hips made of metal and plastic. Airports, hospitals, shopping malls – every place Rip goes baffles him. But when he finally walks into a schoolroom, the old man knows exactly where he is. This is a school, he declares. We used to have these back in 1907. Only now the blackboards are white." (Milton-Freewater, 2007)*

A slight exaggeration to prove a point perhaps, but not that far off from the situation we find ourselves in today. The world is advancing around us, while schools remain in the past.

> *"Today's teachers and children have one foot in the future and the other in the past. Their daily activities foreshadow their future work. But too often when our children walk into their schools, they step into the past, as they enter isolated classrooms to sit behind desks that their parents and grandparents would recognize." (unknown, 2010)*

Figure 1: 1943 Classroom (Eisentaedt, 1943); Modern Classroom (Sekulic, 2011)

We are now challenged to consider learning spaces in new ways. The impact and proliferation of technology and new ways of learning and working are forcing a

re-think of what we have known to be the typical classroom for the past hundred years or so. The physical environment can no longer be viewed as a neutral or passive setting. (Graetz, K. A., & Goliber, M. J., 2002). We now know that it influences a learner to behave differently depending on their environment, setting either constraints or possibilities.

To say that we are living in interesting times is an understatement. Technology enables us to work and learn anywhere, anytime, no longer confined to 4 walls or restricted by time. David Thornburg, a futurist and pioneer in educational technology, states that: *"Modern technologies are space collapsers, time shifters, and creative tools that extend our reach." (Thornburg, 1999)*

This paper examines the future Thornburg alludes to in the context of pedagogy, technology, and spatial design. The result is a guide for teachers to use in the planning of their own classrooms and learning spaces. It is a tool that will promote positive behaviour and motivation for students and prepare them for a future that is unknown. I have chosen teachers as the prime users of the Learning Settings Tool because they are closest to the situation and able to use their own experience, expertise and judgment to affect change in classroom design quickly and effectively. The Tool links emerging shifts in education, to spatial typologies that promote and support these advancements in pedagogy and technology.

1.1 Context, why is this important now?

The future of education, globalization and work has never before been so closely connected. Transformation in the modern work place indicates that it is essential for education to advance in a new direction, focusing on skills that are relevant to this transformation. An IBM survey (IBM, 2010) of more than 1,500 CEO's worldwide identified creativity as the number one leadership competency and as more crucial than rigour, management discipline, integrity or even vision, to navigate the increasingly complex and unpredictable world in which we live.

> *"The effects of rising complexity call for CEOs and their teams to lead with bold creativity, connect with customers in imaginative ways and design their operations for speed and flexibility to position their organizations for twenty-first century success. To capitalize on complexity…CEOs now realize that creativity trumps other leadership characteristics. Creative leaders are comfortable with ambiguity and experimentation. To connect with and inspire a new generation, they lead and interact in entirely new ways."* *(IBM, 2010)*

Traditionally, there has been a focus on teaching children the importance of logical, linear and analytical, left-brain activities. It is becoming increasingly clear that right brain activity [the creative side] is as critical to success in the 21st century, as the left logical side. The shift from an industrial economy to one that is knowledge-based requires a fundamental shift in skills and mindset. Those best prepared for this new economy have the ability to think critically, to identify and solve problems, and are both curious and adaptable. There has been a significant shift from *"The Information Age to The Conceptual Age" (Pink, 2006)*

> *"The last few decades have belonged to a certain kind of person with a certain kind of mind – computer programmers who could crank code, lawyers who could craft contracts, MBAs who could crunch numbers. But the keys to the kingdom are changing hands. The future belongs to a very different kind of person with a very different kind of mind – creators and empathizers, pattern recognizers and meaning*

> *makers. These people – artists, inventors, designers, storytellers, caregivers, consolers, big picture thinkers – will now reap society's richest rewards and share its greatest joys." (Pink, 2006)*

Rote learning traditionally offered in school does little to advance the kinds of skills, competencies, and tools that are required in the world Daniel Pink describes. The future belongs to a new kind of person, one with a very different way of working, thinking and learning. Traditional 'teaching to the test' does not prepare young people for a future that is unknown. We need to teach the whole child.

> *"A report on primary school education in the UK in 1931 said that education had to look to the whole child. It emphasized the importance of play, self-expression and creative activities, which, it said, 'if the psychologists are right, are closely associated with the development of perceptions and feelings'. The dominant tendency to see the school curriculum as a jigsaw of separate subjects had to be questioned. So did presenting work to children simply as lessons to be mastered? Education had to start from the experience, curiosity and the awakening powers of children themselves." (Robinson, 2011)*

Without this focus on the whole brain and the whole child, education will continue to fall further behind. We are witness to significant shifts in all aspects of our world. Work, technology, social relationships, economics, environment, innovation, possibly the most critical of all, education, are all providing challenges and complexity that need to be met with new ways of thinking.

A potential implication of the widening gap between the needs of the current and future workplace, and the learning outcomes of traditional education, may be an increase in school dropouts. In a 2010 Time Magazine article, 10 Ideas for the Next 10 Years, author Reihan Salam (Salam, 2010) argues that, "*if schools continue to prepare next generation students for jobs that soon won't exist, we will see a 'dropout revolution', one that will produce*

new thinking on learning outside of the system." Economists attribute a sluggish wage growth to educational stagnation. As recently as 2006, three out of ten high school students dropped out, and barely one third finished university or college. (Salam, 2010) Billionaire entrepreneur Peter Thiel [co-founder of PayPal and early Facebook investor, and rebel Stanford alumnus] believes that formal schooling is not providing young people with the skills and attributes they need to survive in the 21st century. Thiel made a radical move in 2010, when he launched the Thiel Fellowship program, offering twenty students under the age of twenty, $100,000 each, to forgo or drop out of university and pursue their entrepreneurial dreams. It is his view that they would finish school deeply in debt and jobless, ill prepared for the changing world. He is creating a generation of *Hackademics.* He provides mentorship and resources to learn by doing in the real world, giving them an alternative to the status quo and emphasizing the value of a real world education and lifelong learning.

Students today are still asked to turn-off their technology while at school. For many, this is metaphorically turning off their desire and motivation to engage in learning. Technology cannot be ignored or feared by teachers and administrators much longer; it has had a transformative effect on work, and if we allow it, soon will on education. Soon there will be no choice but to promote mobile learning, Internet research in class, and embrace technology for the potential it creates for learners. The current system is not prepared for total integration of technology at this point; changes must be made to the learning environments.

Similar demands have been placed on workplace design in recent years, and businesses have responded by providing spaces designed to promote collaborative and flexible conditions, that are conducive to 21st century skills and technology. Advancements and transformations in workplace design occurs at a much faster pace, ROI in business happens sooner and is more tangible than in the education system.

Investment is made in keeping employees happy; businesses promote creativity in the workplace and provide the right kind of environments to facilitate this. It is unfortunate that schools continue to be built today using yesterdays ideas. What would it mean for schools to have a culture centered on design thinking and interdisciplinary projects instead of siloed subjects? (Kahl, 2011) Companies such as Google, Pixar, IDEO, can teach us the power of play and creativity for producing serious work. It is ironic that these *grown-up* environments seem more like spaces for children than our children's classrooms. What if learning environments were informed by creativity and expression rather than tradition? Jane McGregor (2004a, p. 13) sums it up nicely when she states:

> *"In a world increasingly characterized by change, diversity and complexity, with educational institutions […] aspiring to become 'learning organizations' and where the 'knowledge economy' is apparently crucial, schools as workplaces for learning […] exhibit physical, organizational and social arrangements that have changed relatively little in the last 150 years."*

Children should not be sent into the past when they are sent to school; their education must be meaningful and true to their life experiences. Many learning facilities are still being designed as they were in the 19th century; focusing on a teacher-centred model, not a learner-centred one. Are the needs of today's students being met through design? The ability for teachers and educators to understand and use physical learning space as an

advantage in terms of pedagogy continues to receive limited attention. We are now challenged to re-think the design of learning facilities, the teacher's role and the suitability to today's changing world.

1.2 Rationale

> *"…a creative personality is prepared through the creative imagination that in the present expresses itself and becomes concrete" - L. Vygotsky*

As a designer, a student, an educator and a mother, the link between creativity and learning is of great interest to me. Are children having their creativity educated out of them, as Sir Ken Robinson (Robinson, Schools kill creativity, 2006) suggests? He believes that creativity is as important as literacy and numeracy, and that it should be treated with the same status and respect. This notion is clearly fascinating people if you consider that Robinson's talk has been viewed by well over 10,000,000 on TED.com alone.

I was one of those children who did not excel at the subjects considered to be at the top of the academic hierarchy of subjects. I was the student who daydreamed, doodled, did poorly in math and annoyed teachers with my questions. There was no contextual learning, no need to understand the concepts being delivered, there seemed to be no room for creative thinking. Discovery was discouraged in favour of repeating right answers. My early education was less than rewarding, motivating or inspiring. What if creativity was valued throughout the child's educational career, the same way literacy and numeracy are. If this new study (Hammer, 2012) on full day, play-based kindergarten is any indication, creativity is showing to be very beneficial in learning. When in their education do children

lose that intuitive ability for creative expression and freedom? I think it happens when they are told to sit still and listen.

The preliminary data collected by researchers at the University of Toronto on the new, full day play-based kindergarten program in Ontario shows the benefits to our children to be significant, scoring much higher than their half-day peers on tests for literacy, numeracy and fine motor skills. Full-day programming and a play-based curriculum, is proving to be a winning combination in Ontario.

> *"The Full-Day Early Learning–Kindergarten program is based on the understanding that children develop within a complex set of interrelated systems that includes the family, the school, the broader community, and the world. Although early learning programs have traditionally acknowledged the importance of these systems, they have tended to address each one separately, in terms of its individual impact on the child. By contrast, the Full-Day Early Learning–Kindergarten program recognizes the importance for the child's development of the interrelationships between and among these systems, and builds on those interrelationships. Holding this interconnectedness at the centre of its vision, the program sets children on a more positive trajectory for learning." (Ministry of Education, 2010 - 11)*

In kindergarten, children learn to think critically and creatively problem solve in a flexible, collaborative, multi-sensorial environment. They feel most at ease and engaged when they are in a comfortable environment that adapts to their individual learning styles and interests. To expect that all styles of learning can apply to all children in one classroom is to move into the banking or factory style of education of a century ago. This was a time when students sat silent, row on row, staring at the backs of their peers while the teacher at the front of the room delivered information. *"Knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing."* (Freire, 1970). Paulo Freire describes this as the '*banking concept of education*'. In this model, the

teacher delivers information to their students, while they are expected to quietly listen, essentially turning students *"into receptacles to be filled by the teacher,"* (Freire, 1970). This is a system that rejects any notion of individuality of the student and their unique styles of learning. They are not heard, they are expected to file away the information fed to them until it is needed for a test or exam. There is little opportunity for students to engage in their own learning, or use their knowledge in a creative practical way.

It must be said that while creativity is now integral to learning in the 21st century, it does not replace literacy or numeracy, it supports it. Every subject should incorporate creativity and/or facilitate creative thought. It is integral to all learning, not an add-on (National Advisory Committee on Creative and Cultural Education, 1999).

As children progress from kindergarten into grade school, those important creative skills that have been nurtured to this point, are often discouraged, and replaced with testing, rote learning and knowing the right answer. There is a major transformation occurring in education, hopefully, this disruption will create the impetus for change. Great shifts are impacting all aspects of education and the 21st Century work force. Everyone from entrepreneurs, CEO's, political and business leaders, scientists, marketers, and architects are recognizing a needed shift from the 20th Century way of teaching to the 21st Century way of learning. **What are the skills and attributes necessary to meet these challenges?** *"The shape of the future workforce is driven by three things: demographics, trends in education and changes in lifestyles." (Arup, 2011)*

Are we asking for the impossible when we expect children to learn these critical new skills and competencies without looking at *how* and *where* they learn? There will surely be a paradigm shift in the area of the expanding learning environment, from classroom to learning environment, and its impact on everything from student achievement to behaviour to retention.

1.3 Focus

The focus of this research lies in the connection between advancing pedagogies and technologies and learning environments and space. Research for this paper will be framed around the questions:

> *How might we link the requirements and attributes of a 21st century learner, with design recommendations for transforming learning spaces?*
>
> *Can teachers become empowered to be active participants in these changes?*

An extensive review of literature: *The Impact of School Environments,* explores the impact of learning environments on student achievement, engagement, affective state, attendance, and well being. The evidence demonstrates that extremely poor quality environments have a detrimental effect on learners, teachers, and other staff. It also indicates that when improvements are made, the benefits are significant. Inadequate air quality, lighting, temperature control, and acoustics have detrimental effects on concentration, mood, well-being, attendance, and ultimately, attainment (Higgins, 2005). Higgins finds unequivocal evidence with regard to the importance of user engagement in defining and solving design problems. The review finds that the most successful designs are likely to be those that are flexible and adaptable to changes in curriculum, future cohorts of learners, and teaching staff (Higgins, 2005).

At the Design For Learning Forum (October 2006), following the National Summit on School Design, a gathering of more than 30 architects, educators, design experts, and students looked at the future of school design.

One participant noted:

> *"We are at a moment in time – a tipping point – when the combination of increased learning opportunities, advances in technology, and changes in teaching and learning are working to change the nature of school design." (American Architectural Association, 2007)*

Architect, school planner and futurist, Prakash Nair defines good design for schools to have 7 key conditions: *Enhance physical comfort and well-being; it must strongly support 21st-century teaching and learning principles; environmentally responsible; serve the educational needs of the larger community as well as the school; be open, transparent and collaborative; be accountable; and finally they must last longer, cost less and be more inspiring* (American Architectural Association, 2007). While these key conditions sound reasonable and common sense, it is a tall order for most school boards. Is this in fact happening? Can it happen as quickly as we need it too? It can't unless the interested parties begin working together towards the same goal (Lackney, 2008). There are also more pragmatic reasons for the challenge in implementing these seven conditions. Previously undeveloped pedagogy, difficulty in upgrading school building design and restricted budgets all contribute to the challenges faced.

Education is no longer just the concern of educators, administrators and the government (Kahl, 2011). We simply cannot wait for Government funding to mandate and pay for the

changes required. Parents, concerned citizens and corporations, are stepping in to offer help in moving this along at a more reasonable pace. We are seeing change in the form of motivated teachers and educators working together to reorganize and repurpose where possible. It is time to take charge and help students thrive.

This research paper will identify the necessary skills and attributes required by 21st century learning and working. It correlates these with major trends in pedagogy and technology to infer the types of space arrangements supportive of learning the required skills. It will then offer a simple tool to assist in identifying opportunities in the layout design of classrooms and learning environments. This tool was specifically designed for the educator, those at the front line of the classroom. This is not to say that we need not look to government for higher-level change, but the purpose of this tool is to engage those closest to the situation in a way that is effective, simple and reasonable to implement with existing resources.

2. APPROACH & METHODS

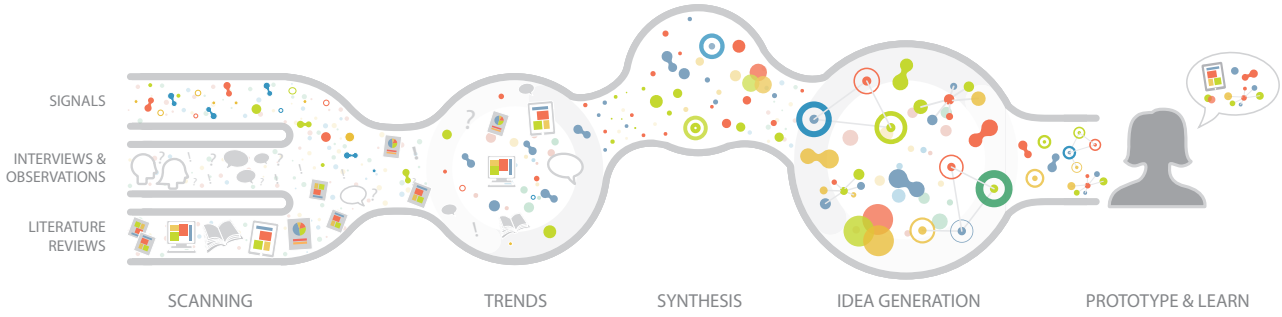


Figure 2: Process Map

2.1 Approach

Several methods were used to gain insight and information about the broad areas this research intersects. Futures research methods, including Environmental Scanning of current realities in the general environment or area of study. Because this is an area of relatively high uncertainty, this information gathering method supported the development of possible strategies and tools for the Canadian K-6 classroom as applied to the design of learning environments.

Environmental Scanning

Early Indicators: As a first step to understanding education in the 21st century, I explored ideas, issues, innovations, events and ideas in education signaling the future. These indications of possible futures led me to establish four main themes and sort them into two core themes as a focus for this paper – technology and pedagogy.

Literature review

I conducted extensive literature reviews and horizon scanning to gain further insight into the state of learning today and in the future. This review of literature sourced through web, video and print, was conducted over a six-month period.

Key areas of focus included:

- Trends in K-12 education
- Styles of learning
- The relationship between technology and learning
- The impact of physical space on learning outcomes

Trends

Prior to the main research conducted for this paper, I was involved in research with The Ambient Experience Lab, OCADU. The work involved research into trends and signals under four main themes: pedagogy, technology, space and sensorial [Figure 3]. The research into trends and signals within these themes led me to the focus of this paper, pedagogy and technology, and their impact on space and experience.

While the methods used have characteristics of foresight, they have been adapted for a design thinking approach, allowing flexibility as needed. I approached this problem in the way I have approached all design challenges, with a user-centred approach, a design thinking methodology to determine the problem area and then examine it through the lens of the learner. In a time of rapid change and multiple variables, uncertainty is high, making strategic planning challenging. Futures research methods allow the articulation of plausible futures in a way that inform choices and decisions in the present.

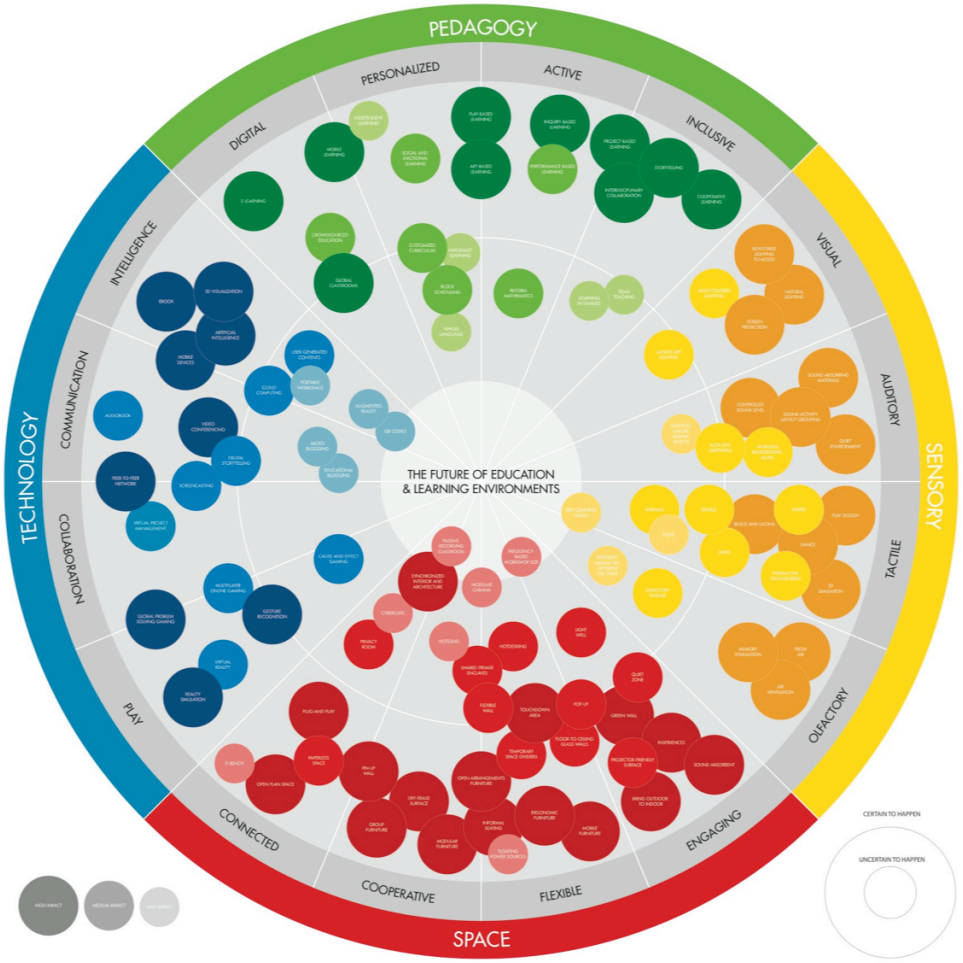


Figure 3: Early Trend Map Developed in Ambient Experience Lab, OCADU [created by Janet Jones and Jeffery Tjendra, with Job Rutgers]

Field Observation

I visited the general areas of Withrow Junior School and a few classrooms, observing various class configurations that were set up by the individual teachers. These layouts and configurations are based on their personal requirements and learning outcomes.

Expert Interviews

Armed with a direction, I conducted interviews with key stakeholders in the domain of education and learning. These included: principal, vice-principal, junior/senior

kindergarten teachers, and grade school teachers. The questions were semi-structured, informal and flexible, which suited the nature of this research.

These initial conversations served to provide me with insight into the day-to-day issues that arise regarding the teaching methods, technology and the environment where children learn.

Synthesis

The intention of this paper is not to make predictions, but to suggest an inclusive, comprehensive and balanced strategy that empowers teachers to become participants in changes that affect them and their students.

The methods used, led to the synthesis of information and ideas, which then led to further concept building and eventually to a resource tool for teachers that can be used as a framework for understanding new pedagogies and configuring space for optimal learning values based on those pedagogies. This framework facilitates a quick, low fidelity hands on approach to creating new environments and spaces for optimal learning.

2.2 Core Themes and Trends

Four key trends are identified in each of the two core themes. This is by no means an exhaustive list, but serves to indicate some of the main forces that are driving significant changes to learning today. When establishing this list, I examined trends using the following criteria:

- Is it evident locally, nationally, globally, and institutionally?
- Is it being recognized in both education and work? Society?
- Is it supported by significant evidence?

Trends play a significant role in the Learning Settings Tool introduced in section 4.0. Trends and signals are incorporated into the tool so that teachers may refer to them easily when looking for additional resources and evidence for pedagogy and technology.

2.2.1 Pedagogical Trends

Pedagogy refers to the holistic nature of the professional practice of educators' including instruction strategies and styles. The etymology of the word is Greek, and the literal translation is *to lead the child*. Hinchcliffe's definition is simple yet powerful and relevant to these times. "*Pedagogy can be defined as learning oriented towards social goals" (Hinchliffe, 2001)*. When looking at *how* students are learning, it is important to note that space and technology should be active supporters of the pedagogy.

Four key trends identified for pedagogy are based on the collection of early indicators.

- Play = Learning
- Hands on Learning
- Thinking Like a Designer
- Best of Both Worlds

Play=Learning

Play allows the child to make connections, master essential skills and apply this knowledge to their real world. Play Based Learning supports high levels of adaptability, creativity, critical thinking, and problem solving abilities in young children - skills required to succeed in a knowledge economy. Researchers and educators over recent years have

discovered that Play Based Learning targets the developmental needs of the child; they reflect the cognitive and social stages of development [collaborative, solitary, parallel, cooperative, onlooker and associative play]. Play-based curriculum offers children opportunities throughout the day to develop the ability to think abstractly and creatively by experiencing real objects using their senses.

Play allows children to make connections, master essential skills and apply this knowledge to their real world. Play Based Learning supports high levels of adaptability, creativity, critical thinking, and problem solving abilities in young children - skills required to succeed in the knowledge economy.

Hands-On Learning

Inquiry can be defined as "*a seeking for truth, information, or knowledge - seeking information by questioning.*" (Concept to Classroom). Often referred to as Participatory Learning, it is a student-centred approach focused on questioning, critical thinking and problem solving. Great gains in critical areas of logic, attitude and perception are a result of hands-on learning. Inquiry-Based learning develops habits of mind that encourage life-long learning and curiousity. *"Students who actively make observations, collect, analyze, and synthesize information, and draw conclusions are developing useful problem-solving skills." (Inquiry-based Learning: Explanation)*. These practical 21st century skills can be applied to future situations that students encounter in their real lives both in school and at work.

Thinking Like A Designer

Design Thinking is a methodology that encourages children to have the confidence to tackle complex issues and problems in a collaborative, compassionate, creative and thought provoking way. Design Thinking involves systems thinking and encourages looking at problems in new ways, promoting discovery of an issue and empathizing with those it impacts. *"The next generation will need to be more and more comfortable with problems of dizzying complexity. And design thinking can teach them that." (Le, 2011)*

The Best Of Both Worlds

Blended learning is a combination of traditional face-to-face learning with online methods. The increase in this pedagogy has grown from roughly 45,000 K-12 students participating in online learning in 2000, to over 4 million in 2010. The growth rate continues to accelerate with the pre K-12 online population, at an annual rate of 43%.

Its disruption in the current model of education delivery has the potential to transform the industry. This learning demands new spaces and ubiquitous technology.

2.2.2 Technological Trends

Four key trends identified for pedagogy are based on the collection of early indicators.

- Playing Games
- Out in The Open
- Alternative Realities
- It's Personal

Technology continues to affect the way we work, the way we collaborate, communicate, learn and access information. Increasingly, technology skills are critical to success in almost every field. Those adept at technology will advance further, and those without access or skills will not. The digital divide, is no longer seen as a factor of wealth alone. It is now a factor of education. Young people are in a much better position to succeed in the 21st Century if given the opportunity to learn technology skills. New occupations, multiple careers, and a mobile workforce all contribute to this trend. Amazingly, 30 years after the first computer was introduced into school, integration and use of technology in elementary schools is still not considered the norm.

Technology companies are providing support, research and distinct programs to facilitate technology integration in schools. Cisco Systems commissioned a detailed research report (Fadel, C., & Lemke, C., 2006) citing a myriad of purposes for technology in schools, including improved teaching, leadership, and decision making, as well as student-focused purposes, such as increased engagement, real world applications, and building 21st Century skills among others. According to Cisco's research, technology should be viewed as a tool for student-centric, relevant and rigorous learning.

From a remarkably young age, technology has permeated every aspect of children's lives. This is demonstrated in the recent viral YouTube video (StormLogixLLC, 2011) of a one-year old child using an iPad. The child is intuitively using the device, scrolling, pinching and pointing. After a time, the parents replace the digital device with a conventional paper magazine. The child becomes extremely frustrated with the passive

magazine, when it does not react in the same way as her iPad; at one point she even checks her hands to see if its her fingers that are not working; is that why the magazine is not scrolling? When this child graduates in 2030, what will her school experience be? Will she be expected to turn-off her world when she goes to school? From a very young age, technology has permeated every aspect of our children's lives. Demonstrated in a recent viral YouTube video (StormLogixLLC, 2011), a one-year old child, is intuitively using an iPad, scrolling, pinching and pointing. After a time, the parents replace the digital device with a conventional paper magazine. The child becomes extremely frustrated with the passive magazine, when it does not react to her touch in the same way as her iPad; at one point she even checks her hands to see if its her fingers that are not working; is that why the magazine is not scrolling? When this child graduates in 2030, what will her school experience be? Will she be expected to turn-off her world when she goes to school? Children are living in a digital world and with every device that is being turned-off by schools – students are potentially turned-off.

Playing Games

Video Games are now more prevalent and accepted in the classroom. Games are used to supplement and inspire a student's in-class education. Students teach themselves in interactive and applied ways, not by learning through specific subjects. They are learning everything from geography using Google Earth to science from a first-person shooter-inspired cellular biology game developed by the Federation of American Scientists (Science Daily News, 2009). Games motivate and engage students in ways that make

learning stimulating, memorable and fun, collaborating through social networking platforms and bolstering their critical thinking skills.

Out In The Open

Open Educational Resources, as defined by UNESCO (United Nations Educational, Scientific and Cultural Organization) in 2002, is *"The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes",* the democratization of knowledge. Open learning provides a culture of sharing resources and methods that help facilitate innovation and change in 21st century education.

Alternative Realities

No longer considered science fiction, the simulation of physical presence in both real and imaginary worlds [Augmented Reality], has very real and tremendous potential in education. There is a growing inclusion of additional sensory information such as sound and touch in schools. It is a participatory technology where students learn through computer-simulated environments to perform pedagogical activities.

It's Personal

Personal Learning Environments [PLE] are systems that allow students to manage and take significant control of their own learning through exposure of technologies not traditionally seen in the classroom. Flexibility and customization are key components of a PLE integrated system. It provides opportunities for authentic learning and appeals to

diverse learning styles, and to the Constructivist ideas of education where students take control of their learning.

2.3 Current Status

> *"In a time of drastic change, it is the learners who inherit the future. The learned find themselves equipped to live in a world which no longer exists." (Hoffer, 1973)*

Futurist, Alvin Toffler, in an interview for the website, www.edutopia.com (Daly, 2007), was asked to describe the school that he would create, the ideal school in the future:

> *'…open twenty-four hours a day. Different kids arrive at different times. They don't all come at the same time, like an army. They don't just ring the bells at the same time. They're different kids. They have different potentials…I would be running a twenty-four hour school, I would have non-teachers working with teachers in that school, I would have the kids coming and going at different times that make sense for them. We're individualizing time; we're personalizing time. We're not having everyone arrive at the same time, leave at the same time… schools have to be completely integrated into the community, to take advantage of the skills in the community'*

The culture of school is changing, not quite to the extent that Toffler might like to see. While the student is now at the centre of learning, there is still tension between personalization and standardization in schools, despite the growing efforts by many to personalize the learning experience (Design For Learning Forum, 2005). We can see that in the past standardization has not produced learners that can easily cope with the uncertainty of their undefined future. Children born today will graduate in 2030. What will work look like then? By then will Toffler's vision be the norm for their children?

What should children learn to succeed in the world and work force in the 2030's? We do not know; we can not know, work and technology are changing faster than we can keep up. What we can do is provide students with the skills and tools to be flexible enough to be able to respond to their unknown future. This supports the notion

that it is not so much about the *what* in education, but the *how* in learning. It is essential to learn *how* to learn. Adaptability is key.

As an Industrial Design Educator, I teach my students that when they leave school they should be able to design anything from a keychain to a bike to alternative energy sources. If taught *how* to learn [the process], students will then use the process to apply to the *what* [context]. The process remains the same; the thinking and problem solving structure does not change. I want to see that they approach problems with creativity, critical and integrative thinking, and not look for the right answer, but rather the possibilities.

Content is most effective when used in relation to context. Learners are able to retain information when contextualized and given a sense of purpose. This is often a challenge, even for design students. Mental models of education are ingrained throughout their entire school experience by parents, administrators, media, government and educators. Factory schooling for the masses must disappear before the transformation required can happen.

3. SHIFTS

The following contextual, technological and pedagogical shifts demonstrate the significant changes taking place in education and learning today. Society is changing at an unprecedented pace, and ideally education would follow closely behind. In order for education to implement similar advances, it would mean a complete overhaul. There continues to be incremental change, however, which may progress faster if all stakeholders were in full support. It is not a matter of willingness to change, but the inability to know where to begin this daunting task. Often they lack the practical tools to guide them through the implementation of change.

The emerging shifts play a significant role in the development of the spatial typologies in the Learning Settings Tool. A move from traditional to emerging education cannot effectively happen if design of the physical learning space does not relate to these changes.

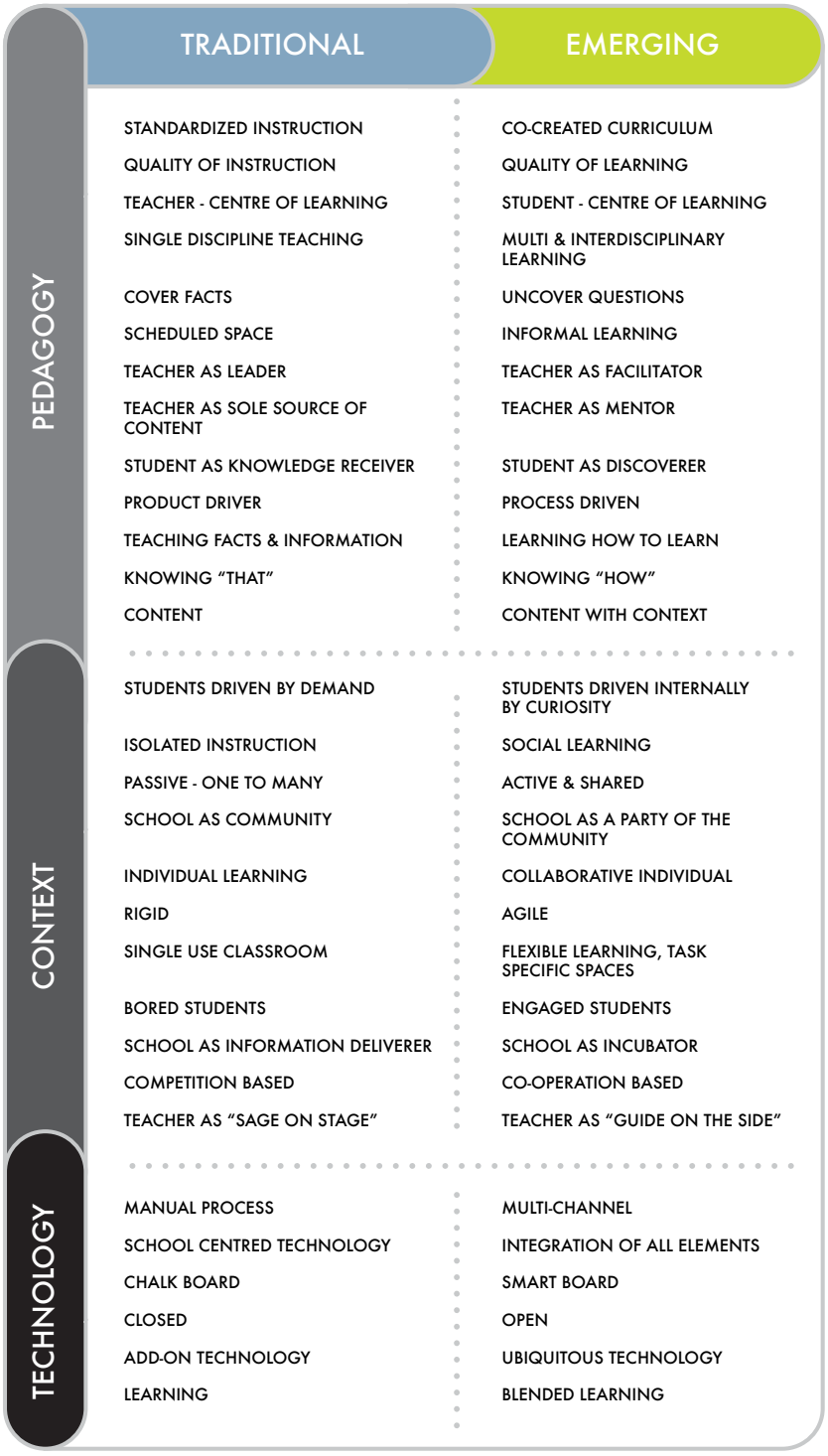


Table 1: Emerging Shifts in Education

Table 1 illustrates some of the significant shifts and changes that are emerging in education. These shifts were established by looking at education in the traditional sense, the factory model of imitation learning, and comparing it to progressive schools that are providing learners with social skills that direct them towards a transforming society.

Figure 4: Shifts in Learning (Cheramie, 2010) (Schmidt, 2010)

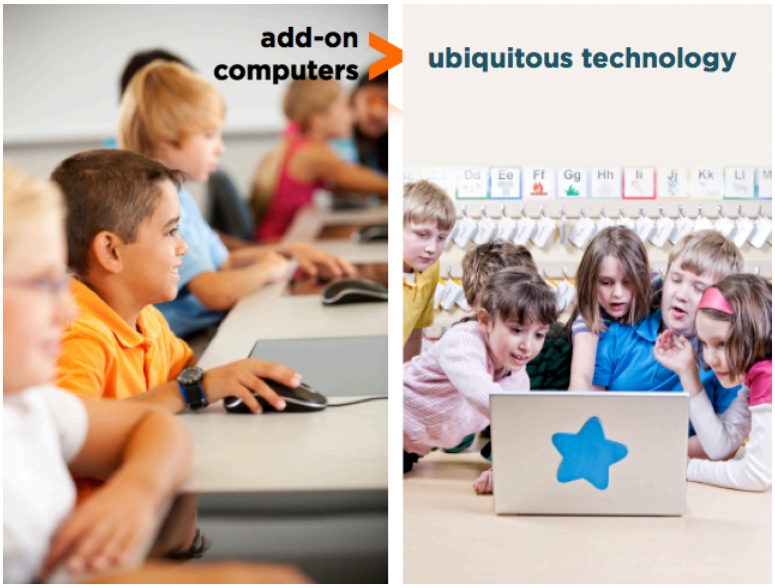


Figure 5: Shifts in Technology (Locke, 2011) (Newman, 2010)

In the early 20th century, the typical classroom was teacher–centred with a focus on memorization and students working quietly in isolation. Students sat in desks in rows, all eyes to the front, which was quite sufficient for the teacher-centred model. Now, however, in the 21st century there is a paradigm shift towards active student-centred learning that is not conducive to rows of desks. We can see that the shifts illustrated in Table 1 are significant. They suggest it is within reason that the environments where learning occurs must be improved in order to facilitate these shifts.

John Dewey, an influential educational thought leader in the 20th Century, believed that education is the fundamental method of social progress and reform. His ideas were ahead of his time – experience, reflections, democracy, community and environments for learning are as relevant today as they were then, in fact, probably more so.

> *"The world is moving at a tremendous rate. Going no one knows where. We must prepare our children, not for the world of the past. Not for our world, but for their world. The world of the future. - John Dewey, 1945*

He recognized that even in the 40s, the pace of change would affect education. Those concerns are still top of mind nearly 70 years later. Children were not prepared then, nor are they now. Dewey's thoughts have laid the foundation for inquiry driven approaches that we are beginning to see today. Dewey describes the four primary interests of the child, which remain today as starting points:

- the child's instinctive desire to find things out
- in conversation, the propensity children have to communicate
- in construction, their delight in making things
- in their gifts of artistic expression.

John Dewey defined the educational process as a *"continual reorganization, reconstruction and transformation of experience"* (Dewey, 1916), he believed that it is only through experience that a child *learns about the world and only by the use of his experience that man can maintain and better himself in the world.* For Dewey, learning was primarily an activity resulting from the personal experience of dealing with a problem.

Learning through real and authentic experiences. Dewey's theories around the learner are based on the ideas that education [or schooling] is not just about the individual – but the individual student's interests coming together with those of the community, or the bigger society, and today with the global society. Dewey believed that it was a person's natural tendency to connect with others *"Learners grow with others",* that human beings have the natural tendency to connect with others. This is true today with advances in social media and a focus on collaborative and multi-disciplinary work.

> *"To see teaching and learning as the act of nurturing is to understand the essence of the phrase, to educate." … It behooves the school to make ceaseless and intelligently organized effort to develop above all else the will for co-operation and the spirit which sees in every other individual one who has an equal right to share in the cultural and material fruits of collective human invention…" (Dewey, 1937)*

It is interesting that past educational thought leaders, fifty years ago, tried to make the same breakthroughs and transformations that many are fighting for today. Collaboration, social, cooperative learning that actively engages the mind, body and spirit. This proves the point that changes in education tend to move at a glacial pace. When we looking at classrooms today, we are stepping into the past and to the way that Montessori, Reggio Emilia, Dewey and Waldorf might have seen it when they recognized the need for radical transformation of the system. It is essentially the same school, in a vastly different time,

but the same school nonetheless. All of these methods were focused around natural and physical environments, and the opportunities they provided for learning, not the factory style classroom that we are all too familiar with today. The importance of how spaces are designed to promote learning connects broadly to approaches developed in the early years of the twentieth century.

One recent book 'The Third Teacher' (OWP/P Architects + VS Furniture + Bruce Mau Design, 2010), aptly named for Loris Malaguzzi's [Reggio Emilia] reference to the environment as the "third teacher", explores the critical link between how children learn and their school environment. The book is a collaboration between educators, architects, designers, and other thought leaders contributing to the conversation. The book promotes being intentional about the environments we create for children based on the experiences we want for them. It contains many relevant case studies and success stories, and it is accessible to all. It is for this reason that I believe it to be a significant voice in this conversation.

In order to encourage collaboration and social learning, we should look beyond the physical classroom, and consider learning spaces. Reggio Emilia practitioners describe these spaces as the third teacher - inspiring a new initiative by that name;
Maria Montessori understood how the school must be prepared for teaching and learning;
Rudolf Steiner founded the Waldorf school, designed to encourage children to share their knowledge, thoughts, and feelings, regardless of their different personalities (Durach, 1998).

Each of these approaches to education enjoys popularity within certain circles throughout the world. While each approach is different, they share several fundamental principles:

- Educate the whole child - mind, body and spirit.
- Learning is social, cooperative and collaborative.
- Learning should actively engage both the brain and the body.
- Learning spaces are teaching tools.
- Parents and the community must be involved.

Unfortunately, these principles are not consistent throughout the system. Those lucky enough to be able to attend these alternative schools, enjoy benefits that remain relevant today. What about the other schools, the other 90%? There is a need to bring these ideas to a broader audience, in a low fidelity way. The key is speed of delivery and the ability to adapt, be flexible and experiment. The tools introduced in section 4.5, developed to address this need, focus on the teacher as the prime user as they are closest to the problem, and in a great position to address and implement change.

3.1 Tensions

We have inherited the 'Second Wave' industrial model classroom. Education has not had great success in 'The Third Wave', the post-industrial age Wave' (Toffler, The Third Wave, 1989). Looking at 21st century pedagogy and technology through the lens of the 20th century classroom is comparable to fitting a square peg into a round hole. It does not fit in the seamless way that it should.

> *Toffler quotes Psychologist Herbert Gerjuoy as saying:*
>
> *"The new education must teach the individual how to classify and reclassify information, how to evaluate its veracity, how to change categories when necessary, how to move from the concrete to the abstract and back, how to look at problems*

> *from a new direction - how to teach himself. Tomorrow's illiterate will not be the man who can't read; he will be the man who has not learned how to learn." (Toffler, Future Shock, 1984)*

Implementing new pedagogies and technologies in a traditional factory style classroom is a challenge at best. They were not designed for collaboration, for agility, for creativity or today's rapidly changing technology. While change is happening faster in some jurisdictions and schools than others, most classrooms were and continue to be, designed to control students. They do not respond to current needs of the modern learner.

So where is the sharp disconnect? What is not changing and why not? Ontario's recent play-based curriculum, still in its infancy, has proven to be successful and innovative. Innovative thinking and programming should not stop there. It needs to be pushed through to higher grade levels. A recently published research by Canada's Public Policy Forum, echoes this sentiment when it says:

> *"Innovation need not be limited to the upper reaches of the education system. Indeed, the cultural issues of risk aversion and poor entrepreneurial culture which afflict Canada are attributed by some to gaps in K-12 education". (Conway, 2012)*

The design of physical school environments is a big contributor to this divide. It is lagging behind, and contributing to our children being poorly equipped to cope in situations that require them to be collaborative, adaptable or to think critically.

While advancements in pedagogy and space are rising over time, it is not happening at the extreme rate that technology is. *Ubiquitous computing*, the widespread availability of portable, networked technologies, offers an enhanced model of access to computing technologies to provide just-in-time, when-needed computing (Gardner, 1994). Students are empowered to use technology in the classroom as it is at home. With ready access to

ubiquitous technology in schools, learners and teachers are enabled to explore and discover in ways they can not when limited by time in a computer lab.

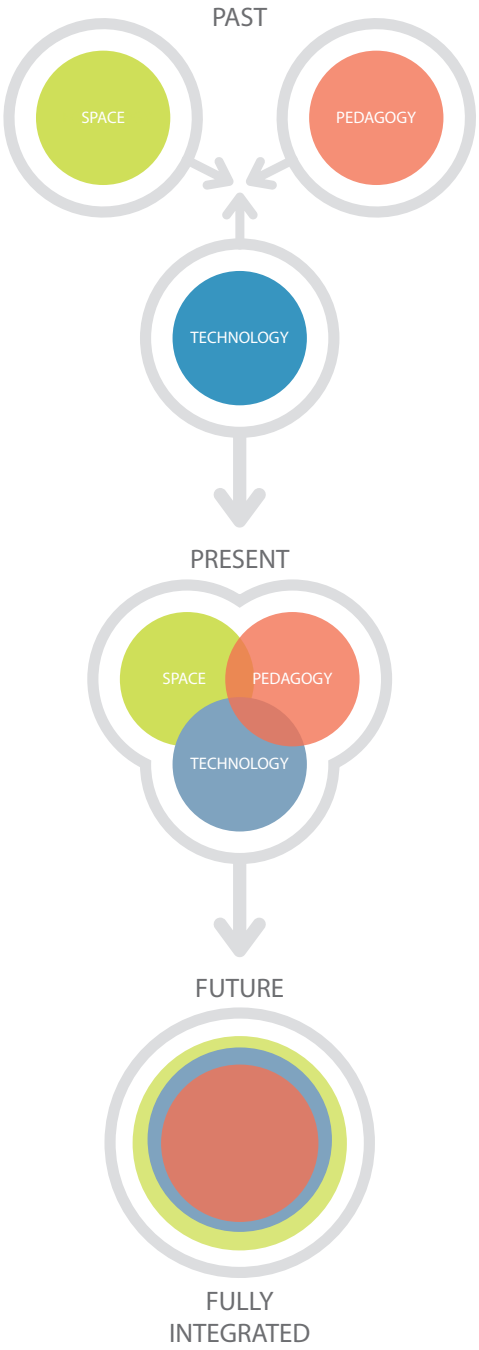


Figure 6: Integration of Pedagogy, Technology and Space

In order to understand the complexities, we must first look at the changes that are making new demands of students. In a recent American Architectural Foundation white paper, former principal Elizabeth Lodal, states that students today:

> *"…Need to be inspired to become creative problem solvers and intellectual risk takers so that they are prepared for the world of the 21st century. School design will either inhibit or support and enhance such a robust education program."*
> *(American Architectural Association, 2007)*

In order to understand the complexities, we must first look at the changes that are making new demands of our students. In a recent American Architectural Foundation white paper, former principal Elizabeth Lodal, states that students today:

While this study was specific to tertiary learning spaces, there are valuable insights that can be applied to all levels of education. Flexibility is a crucial component of high performance environments, facilitating various ways of learning in multiple settings.

3.2 Insights

For more than 20 years, I was a practicing Registered Interior Designer. It is partially because of this experience that I am interested in understanding the role that the physical environment has on the occupant, in this case the Learner. Looking at schools from a designers' point of view, I see more often than not, that the user was not considered. How are children going to learn in this space? Will this space promote the type of learning competencies that are needed? Or, is it merely a space to house children for 6.5 hours a day, filling their heads with information they are unlikely to retain. Unfortunately, it is still complicated for educators to link their pedagogic needs to the layout of learning spaces,

not without help anyway. The intent of the Learning Settings tool proposed, is to alleviate some of this anxiety and complication.

The built environment is meant to support the activities of the people that inhabit the space. In this case children are the *users*. There was a time when that meant scaling down adult furnishings to fit the size of a child. Seemingly little thought went into the activities that they were participating. Is it a case of original users responded well to the space initially, but less over time? People change, pedagogies change, kids and needs change, however, school buildings essentially stay the same. How can we make the physical space adapt to changing needs? If the architectural space is difficult to change, then a flexible layout for the existing space may be a practical solution. *"We shape our dwellings and afterwards our dwellings shape us." - Winston Churchill*

A design approach that failed primarily because the users and stakeholder's needs were not considered was the open-plan classroom of the 60s and 70s. This is evidence to indicate that physical design solutions in isolation without the support of pedagogy or educators, is not enough. School designs cannot be imposed nor bought off–the-shelf. Innovative in its day, the open plan school failed, due to disconnect with everything from pedagogy to mental models. *"Reform the environment: stop trying to reform people. They will reform themselves if the environment is right." - Buckminster Fuller.* Why was there such strong resistance to the open space concept? Many teachers, administrators and parents, were not ready for such radical change. *Teachers hated them, calling them goldfish bowls and blaming them for contributing to burnout. The protests and controversy they provoked at board*

meetings and other forums, in any case, made them flashpoints of public anger (Gidney, 1999). Lecture style teaching did not work in this design and teachers were often reluctant to move to the interactive style of teaching that open environments support. The schools were often ill considered and thoughtlessly rolled out. Soon the flexible and movable walls were made permanent, the open, collaborative space divided into familiar classroom cells. However, some open plan schools have survived, and are used as intended forty years ago. This is an example of how slowly change can occur in education.

Reasons for the mass rejection of the innovative open plan school, include the natural tendency of a teacher to teach the same way that had been taught, as pointed out by researcher and educational change expert, Andy Hargreaves (Hargreaves, 1988). Many reasons can account for the cycle of sameness that we have seen in school design, one of the most significant is that teachers were not trained or prepared for an innovative new pedagogy. This was *Innovation without Change* (Brogden, 2007). Simply being innovative with architecture and design is not enough. If educators are not ready or able to innovate within it, if pedagogy and technology are not in synch with the new design of physical space, it is very likely to fall flat. Physical design solutions in isolation without the support of pedagogy or educators, is not enough. Expecting teachers to change and adapt to architecture is not an effective approach. They must be on board and considered to be important influencers in the design.

The history around the open planned school of the 60s and 70s is relevant for a several reasons. The most salient, in my view is that pedagogy is now ready for this change. The

open plan was ahead of its time, and with technology finally making its way into schools, it may just be the best option. The pace of change in technology requires flexibility for the space to be effective; redundancy is not an option. We must plan for possibility. Within that framework, careful planning and thought can produce an environment where 21st century children can thrive. Stakeholders must be involved in this planning in order for it to be effective and embraced. Researchers have discovered a link between style of teaching and room organization and layout (S Horne-Martin, 2002). What is not understood is: which is the cause and which is effect?

When students are in a comfortable environment that adapts to their individual learning styles and interests, they feel most at ease and engaged in their own education. Children are not generic, and a one-size-fits-all approach to the spaces in which they learn, will not produce the *"creative problem solvers and intellectual risk takers"* (American Architectural Association, 2007). The knowledge economy is looked to for innovation and success.

What attributes are vital to produce these learners?

3.3 Who Is The 21st Century Learner?

> *"We find that when we talk about 21st century skills, people often reduce them to skills for the workspace and skills involving technology and we really are thinking about skills for creativity, for civic engagement, for social life, the full range of experiences that young people will be involved in the future." (Jenkins, 2006)*

In a complex and changing world, the right skills and attributes can contribute to the ease and success of navigation; table 2 illustrates key attributes for 21st century readiness. Based on trends outlined in section 2.2, examining changes in pedagogy and technology,

and extensive literature review in areas from workplace and business, to social and education, I narrowed down the attributes to the four deemed to be most critical and commonly recognized by researchers and educators. I examined trends, corresponding signals and established a rating system for attributes that were critical to the corresponding pedagogy or technology. There is a large body of work on the topic of 21st century learning, and attributes and skills necessary for these times, wording varies, but the sentiment is the same.

Bob Pearlman, in the recent *book 21st Century Skills* states that:

> *"There is a growing recognition in the United States and other countries that 21st century knowledge and skills not only build upon core content knowledge, but also include information and communication skills, thinking and problem-solving skills, interpersonal and self-directional skills, and the skills to utilize 21st century tools, such as information and communication technologies. The Partnership for 21st Century Skills (2003) has defined and articulated these 21st century skills."*

While each pedagogy and technology trend involves many of the attributes, some are more prominent than others. This is of course not to say that the remaining attributes are not valid. They just fall lower on the priority list in the context that I am working within. The challenge lies in the application of these attributes into the learning space of today. I have investigated the correlation between the key attributes and the top four pedagogy and technology trends.

Table 2 is broken into two categories of key attributes, social/personal and problem framing/solving. It includes corresponding attributes and how each applies to the student,

space and place. Each attribute is ranked high, medium or low based on the perceived value and importance of that attribute as it relates to both the student and space.

The priority attributes are as noted:

- Critical Thinker
- Flexible and Adaptable
- Collaborative
- Creative and Imaginative

CATEGORY	ATTRIBUTE	THE STUDENT	SPACE & PLACE	PRIORITY
PERSONAL/ SOCIAL	FLEXIBLE & ADAPTABLE	The student is able to adapt to many situations, learning styles and change. They are not afraid to experiment or improvise, and have a willingness to try new things.	Depending on the activity, the furniture and/or space may be easily re-configured to suit the desired outcome.	H
	COLLABORATIVE	Students interact and work with others in project teams as well as peer to peer or cross age tutoring.	Space must be conducive to team work, with a variety of conditions. Wall, pin up space, comfortable and varied seating, flexible tables; a 'Collaboratory'.	H
	SOCIALLY & CULTURALLY RESPONSIVE	Students are empathetic and responsive to their environment, peers and community. These interactions encourage learning through experience.	A non-traditional space that promotes and encourages interaction and learning through doing or being. ex. community, school garden, or playground.	M
	CREATIVE AND IMAGINATIVE	Students use lateral thinking, divergent thinking, associative thinking, and questioning through play and experiencing. Creativity is key to thriving in rapidly changing world.	Best suited to open spaces that are conducive to expression, and free thinking. Should have access to wet areas, wall space, variety of work spaces, materials, display and furnishings. They should have access to peers while engaging in creative activities.	H
	SELF-DIRECTED	Students can think for themselves and develop knowledge from many sources, and lead in their own learning.	Requires a variety of special conditions. Individual quiet spaces, ubiquitous technology, access to information, peers and mentors.	L
PROBLEM FRAMING AND SOLVING	CRITICAL THINKER	Students are able to gather and assess information, raise questions and problems abstractly.	Critical thinking requires both collaborative space, as well as heads down and quiet space. Flexibility in furnishings and space arrangement is key, as is sufficient wall space.	H
	COMFORTABLE WITH AMBIGUITY	Students do not feel the need to know the right answer. It is more about encouraging them to ask the right questions.. They are comfortable with uncertainty and embrace ambiguity as an opportunity and inspiration.	A space that can be anything to anyone at anytime. Could be a traditional classroom one minute or a lab the next.	L
	CURIOUS	Students as researchers. They are inquisitive and open to learning. They do not take anything at 'face value'.	Curiosity happens everywhere and in every situation. Spaces that encourage exploration and discovery are especially suitable to foster curiousity; ex. outdoor spaces, technology enabled and non-traditional spaces.	M

Table 2: Key Attributes of a 21st Century Learner

3.4 What Is The 21st Century Learning Environment?

If we know that 21st century Learners, require strong attributes in certain areas to succeed, we can ensure that the spaces in which they learn are designed to foster these. If creativity and imagination are key to Inquiry Based learning, for example, then a traditional classroom with a factory style agenda, will not promote the attributes associated with it.

While researching, it became evident that there are many patterns between the modern 21st century learning environment and the commercial workplace.

> *"Advances in commercial office space optimization resulted from rigorous analysis, sustained over long periods of time, on what knowledge workers actually do and how their physical environment - the office - can help them do it. Such an analysis for K-12 schools - one that looks at what different pedagogical models are trying to do and then investigates how the physical environment can help them do it - is long overdue." (De Gregori, 2011)*

As De Gregori stated, design of learning facilities is still in its infancy in terms of research. Return on Investment [ROI] for improvement in physical design, in business, has shorter time frames than education's long time horizons. The measures of success caused by the changes and advancements are more difficult to determine in education than in business. Several well-known office furniture manufacturers have conducted independent research on the subject of design for learning spaces. One of the largest and most well respected, Herman Miller, has an entire website devoted to education and research into learning spaces. Their site provides essays, research summaries, case studies, links and other resources. Other companies that have provided extensive research into the area include Steelcase, which publishes and shares valuable research and insights. However, while the large office furnishings companies have conducted research into higher education and

learning spaces, there is still a lack of research into the area of primary school learning spaces and furnishings. The focus on research has primarily been on higher-grade and University level.

> *"By marked contrast, one space type that has undergone considerable advancement in terms of its functional optimization is the standard commercial office space. Looking back, for example, at Frank Lloyd Wright's iconic Larkin Building from the turn of the 20th century, we can see a then-current model of "knowledge work" clearly and directly reflected in the physical layout of the desks and other furnishings within the great hall space. Fast forward to a contemporary office with its varied spaces for individual and group work, located on a modular raised floor and tied together with advanced, interlinked technology, and we can see how new models of knowledge work are being supported by new models of interior furnishings, layout and design."(De Gregori, 2011)*

The 20th century work place has changed significantly, from typing pools to flexible, collaborative spaces that reflect the many styles of work. Let us look at the modern classroom in contrast. The conventional row-on-row layout of desks and rigid, uncomfortable chairs still rules 100 years after its introduction. If the office can evolve to respond to the work and the people engaged in that work, so too can the modern learning space.

> *"The factory model thought of education in terms of mechanically turning out educated students, so schools resembled factories turning out products in industrial America. This model gave us what we can, even today, refer to as the "typical" classroom: lined-up rows of utilitarian students' desks and chairs in front of a blackboard or a whiteboard behind a raised teacher's desk, fluorescent lighting, minimal windows and uninspiring interior colors, furnishings and design." (De Gregori, 2011)*

4.0 DISCOVERY

> *"…Designing a room for learning is very complex. No one knows how to prevent 'learning-loss' when you design a room "pedagogically", whereas we know lots about designing for minimum heat loss'". (University of Newcastle for Design Council, 2005)*

The rapid pace of change in technology is both an opportunity and a challenge for schools. Technology is by far the biggest driver for transformation in schools. Transformation in pedagogy can be seen as a result of technology's influence; it is driving new ideas and methods in learning for 21st century. The impact of technology in education can be summed up in three words as the new *Three E's of Education*, according to the 2011 study of the same name: Enabled, Engaged, Empowered (Project Tomorrow, 2011).

ENABLING students to reach their potential through increased access to educational resources, and experts that extend learning beyond the capacities or limitations of their school or community.

ENGAGING students in rich, compelling learning experiences that develop deeper knowledge and skill development especially the problem solving, creativity and critical thinking skills so highly desired for our world today.

EMPOWERING students to take responsibility for their own educational destinies and to explore knowledge with an unfettered curiosity, thus creating a new generation of life long learners. (Project Tomorrow, 2011)

If we are successful in **enabling** students to have increased access to resources while at school, **engaging** them in real world problem based learning and **empowering** them to take

initiative and control in their own learning, we can be successful in preparing them for a future that is unknown. This of course has implications to the space in which students are learning. In the following sections I will explore in detail the specific implications to interior learning space design.

4.1 A Call to Action

Through extensive literature review, I discovered one particularly salient journal calling for additional research in the area of *teacher environmental competence*. Environmental competence as defined by one researcher (Steele, 1980) is: *the awareness of one's physical environment, the impact of one's activities, and the ability to use or change the environment to suit a goal and activities.* He argues that most occupants underutilize the potential of their environment, and tend to accept it as *just fine*, rather than do anything to make it *great.* Lackney's abstract:

> *Teacher environmental competence, the ability to understand and effectively use physical instructional space for a pedagogical advantage, continues to receive limited attention in education. Exploring the perceptions of 20 teachers at five urban elementary schools, this study investigates teachers' understanding and effective use of the physical environment to meet instructional goals. It examines organizational factors that contribute to poor environmental competence in school environments. The action research approach employed in this study includes a set of interconnected training, research and action activities. Once teachers were introduced to a means of communicating their environmental experience through the training component, they were able to articulate specific environmental concerns, see their interrelationship, and make judgments of priority. The paper suggests avenues for raising the environmental competence of educators within the context of educational reforms advocating for collaborative, learner-centered. (Lackney, 2008)*

It is evident from Lackney's (2008) research that much more needs to be done in terms of teachers and raising their environmental competence. His interview process with twenty teachers in five schools indicated that they were far less cognizant of social interaction,

privacy, personalization and other vital attributes of the school environment, than they were the indoor air quality and acoustics, [these dominated their awareness]. If teachers were in new, comfortable schools, would they be more likely to focus on higher-order pedagogical goals? Creating collaborative, project-based arrangements; using outdoor spaces for learning; allowing personalization and some sense of ownership over students spaces, are currently not on the radar for many teachers.

Lackney (2008) discusses the results of his study and points to the value of investigating ways to expand and improve their understanding and use of the environment as a teaching tool. His study illustrates and supports the presupposition that the problem of environmental competence concerns the entire organization, not just its individual members. The ability to organize and conduct a systematic and comprehensive process of identifying school environments is not a "collective competence" (Steele 1980) that many schools possess. He noticed that after some involvement in a workshop, teachers in that workshop showed improvement in their environmental competence (Lackney, 2008). There is certainly a need for an increase in environmental competence in order to be able to implement meaningful change. While research into physical design in K-6 is somewhat limited, there has been significant research on the issue of physical comfort in the classroom. Day-lighting in Schools: An Investigation into the Relationship Between Day-lighting and Human Performance, looks specifically at the relationship between good lighting [daylight] and reading skills, while others have studied how *"learning involves the body through our senses and emotions movement through the space"* (Heschong Mahone Group, 1999) and how it is an essential aspect of the learning experience.

4.2 What Does it Mean For Learning?

"The environmental qualities of classrooms—high/low, open/closed, big/little, vertical/horizontal do indeed affect the learning process in young children" (Dyck, 1994, p. 43).

The direct link between a child's success, and the physical design of a learning environment is evident. It presents itself through student behaviour, motivation and even on test scores.

> *"Environmental scientists have published dozens of studies that show a close correlation between human productivity and space design. This research clearly demonstrates that students and teachers do better when they have variety, flexibility, and comfort in their environment—the very qualities that classrooms lack." (Nair, 2011)*

The focus in this paper is the layout and space design implications of the K-6 learning environments, developing a tool that will aid stakeholders in their own design exercise. While it is impossible to anticipate every possible condition, I will include the conditions that will fit within the pedagogies and technologies identified. For context, I will use Withrow Public School, Toronto as a case study. It is a fairly typical public school in the Toronto District School Board, and for full disclosure, is the school my daughter currently attends grade for 1, and my son attended from Junior Kindergarten until grade 6 (finishing in 2009).

> *"Withrow Avenue Public School is situated in Riverdale. The school has rich history and celebrated its 100th Anniversary in 2003. The school's current building was constructed in 1972, and was designed around the open-concept model that was commonplace for the times. We are a dual-track school, offering both an English and Early French Immersion program to approximately 600 students. The building also houses the Withrow Childcare Centre as well as Quest Alternative Senior School. Withrow is also a focal point for the community and is used by community groups outside school hours." (www.tdsb.on.ca)*

Withrow School is vibrant and diverse, with strong parental and community involvement. Recognized as a Gold Eco School[1], Withrow has a teaching garden on site as well as several clubs and committees to support their green goals. The Arts are integrated into every aspect of the curriculum, and the school is lucky to have specialist teachers in many areas, as well as community parents and volunteers contributing their talents to the students learning. Withrow has a very rich history that dates back to 1901, and it is said that the grounds were, at one point an aboriginal encampment.

Their mission statement embodies the attributes of the 21st Century learner, as is evident from their Mission Statement:

> *"Withrow Public School is a dynamic community of lifelong learners working together towards equity and excellence through trust, mutual respect, co-operation, and critical thinking in the pursuit of knowledge. To this end:*
>
> *-We accept the challenge of working for positive change.*
> *-We foster an inclusive environment where the contributions of all are encouraged.*
> *-We take responsibility for our learning, actions, and interactions.*
> *-We seek to become confident decision makers and socially responsible citizens."*
> *(www.tdsb.on.ca)*

For these reasons, I consider Withrow to be a very good example of 21st century pedagogical practices, locked in a floor plan of the past. Teachers and staff do reasonably well accommodating their methods to their surroundings, making various spaces work for

[1] *Ontario Eco Schools is an environmental program that addresses both the operation of the schools and what the students learn. It has been designed collaboratively by school boards for school boards to incorporate environmental education as well as environmentally responsible action into the school setting. Student success – in both academics and positive contributions to society – is the focus of Ontario Eco Schools. The program aims to influence young people during a formative period of life, and affect an exponential impact as children take a culture of conservation home with them. http://ontarioecoschools.org/*

them. However, there are certainly areas that could be better developed to support their learning goals for students, and to promote an even more motivating attitude among learners.

4.3 What do Teachers Really Need?

While significant innovations are beginning to emerge in school design, they are mainly reserved for the privately funded, for the few. Government moves slowly and with caution, and in many cases, they are risk averse, inhibiting of innovation. How can changes be made more efficiently, and at a more grassroots level? What is the best tool to help school stakeholders [teachers and administrators] create more successful environments for themselves and their students? There are risks in producing standard floor plans for teachers to follow. Without the information, context, meaning and criteria, how will teachers know which floor plan best suits their situation or teaching style? The plans might be fully implemented without first taking into account the issues and implications behind them. Another challenge is that every group of children and each teacher different, therefore, standards become difficult to establish or follow. There are too many variables to consider, making it difficult and confusing for the teacher to use. Providing floor plans out of context is not a valuable resource in this case.

Children today are growing up to be more independent and self-directed, from a remarkably young age, navigating the complexity of technology, relationships and the world around them. To believe that we know how to serve their needs without involving them is doing a disservice to the learners and teachers so deeply immersed in the

situation. By encouraging teachers to participate in their own classroom design, they are immersing themselves in the experience, and able to see it more clearly from the students perspective.

Researching many different Design Thinking frameworks, I have taken a user-centred approach to K-6 learning spaces when considering the design of a new tool. The concept that I will further explore is design as process, a way of creating the necessary action to reach desired goals. This leads to finding the real problem, framing it and then planning a call to action to solve it. Involving the stakeholders in this exercise, will allow them to consciously experience the space through the eyes of the learners taking an empathetic point of view.

The value of user-centred design plays a significant role in the development of recommendations for designing places for learning. The goal of the Learning Settings Tool is to identify design solutions that would reduce user frustration, increase usability, learnability and satisfaction. User or learner experience, while broader, is directly related to usability and satisfaction. User experience is included in user-centered design and takes into account aspects related to improving the design, focusing on the user needs, desires and even limitations. The issue when attempting to design standard layouts for the K-6 age group is that there is such a vast range in development throughout these years, it is difficult to determine standards that might be easily applied to all. Another issue is the idea of pre-existing mental models. Teachers may implement suggested layouts, but continue teaching the way that they have done previous to the changes. Not because they

are not open to change, but simply because of the mental models they have established. If an educator is involved in the research of their own students and the activities that they normally engage in, the educator will see for him/herself intuitively, with the help of the learners, ways that will maximize their efforts.

I discovered through the course of my research that, until now, there has been no standard practice or system in place for easily developing a successful classroom layout. It is most often left to the individual teachers to plan the spaces to the best of their abilities, with limited assistance [Figure 7]. In many cases, where the teacher has not researched the area of pedagogy and environment, the result can be at worst - detrimental to the students, at best – fine. Classrooms risk becoming environments that are chaotic, difficult to navigate, lack organization, have very limited space to store and display a child's work, and can create an atmosphere that promotes stress and inability to concentrate. How then can a classroom be designed to provide learners with their social, cognitive, physical and emotional needs being met?

The environment in which children learn influences their behaviour, both positively as well as negatively. It can be quite a challenge for a teacher to plan their lessons and the classroom at the same time. The Design Thinking framework that I am suggesting can be compared to the Backward Design model of curriculum development. Grant Wiggins coined the term in his book, Understanding Design (Wiggins, Grant, and Jay McTighe, 2005), suggesting that in planning curriculum, start with the outcome, or goals, then deliver the lesson plans. One popular metaphor when describing Backward Design is as a

roadmap.

First decide on a destination, and then use a roadmap to go to final destination.

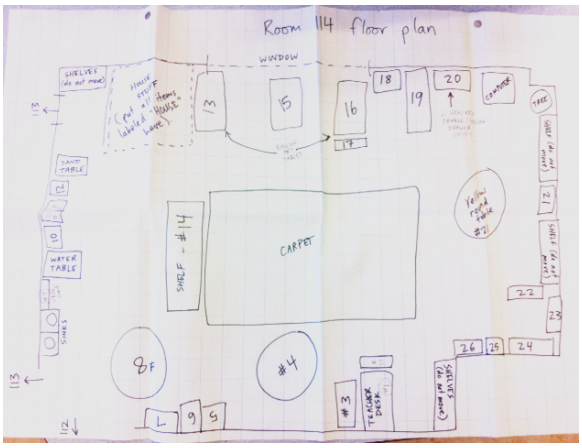


Figure 7: Classroom Layout Produced by JKSK Teacher

Surprisingly, traditional space design for learning, often just hits the road, hoping to reach the desired final destination. The idea when faced with the challenge of designing learning spaces is to start from the end and work backwards. Some approaches may allow us to create spaces that appear aesthetically successful on the surface, but the function, effect on behaviour and learning outcomes, are less so. We will start with the end goal in mind, and work from there.

What is the learning experience we want to create for the students? One research paper that looks at three successful case-studies for school design *[Crow Island School, Winnetka, Ill., Phillips Exeter Academy, Exeter, N.H, and The Discovery Charter School, Newark, N.J]*, concluded that:

> *"What these three schools have in common - despite clear social, cultural and pedagogical differences - is that the physical environment has been intentionally designed to support each school's model for teaching and learning. The physical environment - in this case, the classroom - is not treated simply as a background*

> *setting within which teaching and learning occur, but as an active variable that supports and enhances both. In these instances, the physical environment is no longer distinct and somehow separate from the learning environment; it is an integral and, in fact, critical component of that environment". (De Gregori, 2011)*

De Gregori (2011) goes on to note that all three environments had the active involvement of the teachers and educators throughout the entire process. It was not just a design team who was lucky and got it right. The teachers played a significant role in the success of their classroom design.

Creating a tool that empowers educators to take an active role in the design of their own learning environments, will have significant benefits to the schools, the classrooms, the learners and teachers.

4.4 Layout Typologies

The following tables illustrate seven layout types that correlate to the attributes and activities for the space. These layouts are descriptive only. Not prescriptive. They are meant to be used as a guide, something to provide teachers as a starting point and a base to work from, it is extremely difficult to propose *standard classroom layouts*, especially to the K-6 bracket without taking into account the many variables and conditions. The K-6 classroom is unique when compared most middle schools and certainly high schools in that the students stay in the same classroom for all classes and subjects, where the older grades move from one room to the next. This creates a unique opportunity or challenge where versatility and flexibility are more more critical. There is no single layout that is perfect for all types of teaching and learning; that said there are some layouts that are

better suited to certain teaching styles than others. The layout typologies provide recommendations and room for a teachers' own input and experience. Tables 3 and 4 served as the base for the design of the Learning Settings tool introduced in sections 4.5 and 4.6. Without processing and organizing the data into these tables, the logical flow of the tool could not have been designed.

Table 3: Learning Setting Correlations

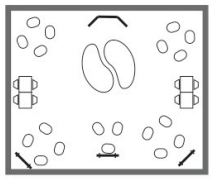
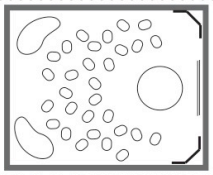
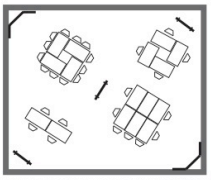
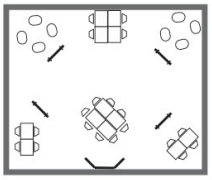
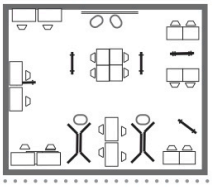
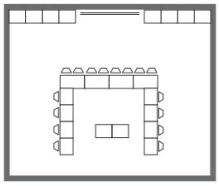
LEARNING SETTING	ATTRIBUTES	ACTIVITY	LAYOUT TYPOLOGIES
COMMUNITY HUB	- CREATIVE & IMAGINATIVE - COLLABORATIVE - SOCIALLY & CULTURALLY RESPONSIVE - CRITICAL THINKING - SELF DIRECTED	INTERACT EXCHANGE ENCOURAGE SHARE COMMUNICATE	
PRESENTATION SPACE	- CREATIVE & IMAGINATIVE - SOCIALLY & CULTURALLY RESPONSIVE - CRITICAL THINKING - FLEXIBLE & ADAPTABLE	PRESENT SUPPORT LISTEN PRACTICE SHARE PERFORM	
STUDIO	- CREATIVE & IMAGINATIVE - COLLABORATIVE - COMFORTABLE WITH AMBIGUITY - CRITICAL THINKING - FLEXIBLE & ADAPTABLE	CREATE QUESTION EXPLORE IMAGINE PLAY	
COLLABORATORY	- CREATIVE & IMAGINATIVE - COLLABORATIVE - SOCIALLY & CULTURALLY RESPONSIVE - CRITICAL THINKING - FLEXIBLE & ADAPTABLE - CURIOUS - COMFORTABLE WITH AMBIGUITY - SELF-DIRECTED	DISCOVER EXPLORE IMAGINE ENCOURAGE SHARE EXCHANGE COMMUNICATE GENERATE	
HUDDLE POD	- SELF-DIRECTED - CRITICAL THINKING - FLEXIBLE & ADAPTABLE - CURIOUS - COMFORTABLE WITH AMBIGUITY	RESEARCH PLAN COMMUNICATE SHARE THINK REFLECT STUDY	
LEARNING GARDEN	- CREATIVE & IMAGINATIVE - COLLABORATIVE - SOCIALLY & CULTURALLY RESPONSIVE - CRITICAL THINKING - FLEXIBLE & ADAPTABLE - CURIOUS - COMFORTABLE WITH AMBIGUITY - SELF-DIRECTED	EXPLORE DISCOVER SHARE IMAGINE GROW INVESTIGATE PARTICIPATE CROSS-POLINATE	
FOCUS LAB	- CREATIVE & IMAGINATIVE - COLLABORATIVE - SOCIALLY & CULTURALLY RESPONSIVE - CRITICAL THINKING - FLEXIBLE & ADAPTABLE - CURIOUS - COMFORTABLE WITH AMBIGUITY - SELF-DIRECTED	EXAMINE INVESTIGATE RESEARCH QUESTION REASON	

Table 4: Layout Typologies

4.5 Introduction to The Learning Settings Tool

To date, the tools and resources that have been designed to aid teachers in designing their own space have consisted mainly of rudimentary drafting tools based strictly on physical criteria [room dimensions, location of doors and windows, size of standard furnishings and number of students]. Existing tools fail to connect design to the pedagogic and technological requirements. These tools do not give teachers the context or the opportunity to create an effective layout based on any real criteria. The teacher still must do the classroom layout, but how do they know if it is the right layout for their individual need? They do not. What they end up with is an arbitrary layout, based on nothing but a kit of parts provided by the developer. No instruction or guidance is available to assist with what to do with that kit of parts.

The challenge in the design of the final *Learning Settings* tool was to provide a useful tool with teachers in mind, one that can assist in determining what information is relevant, and what is not. While considering the information that teachers might need when planning their classrooms, I realized that it could not easily fit onto one table or even three. There are several types of information that need to be indicated in different ways, with different hierarchies. To be consistent with a discussion about the future of learning spaces, the tool should promote future thinking, in efficiency and ease of use. It allows teachers and educators to use the information they have gathered about their own spaces, their students and desired learning outcomes, to create a learning environment that best reflects and supports their goals for students. The following scenario illustrates the process and the

steps involved in using the tool. It is intended to be user friendly, provide the appropriate recommendations based on the teachers' own parameters and input.

4.6 There's an App For That

Introduction to the Learning Settings On-Line Tool

Ms. McKinney teaches a 4th grade class with 23 very busy students. She realizes that the classroom layout has felt awkward, difficult for the children to navigate and seems to be promoting disruptive behaviour.

Ms. McKinney has no design background and finds the idea of planning her learning environment intimidating; she wants her students to be comfortable and happy while in class. She consults the new *Learning Settings* on-line tool, created specifically for K-6 learners. She recognizes the importance of student success and motivation to their learning environment and wants to ensure that she is giving her students the best learning environment in which to thrive.

Using the tool

Ms. McKinney opens the interactive tool on her device and runs through the demo and simple to use directions and begins.

1. "Log in to your account"
2. "Select an item from the menu options" *she first selects Current Trends and then Learning Settings Tool*
3. She then runs through the selection of criteria [pedagogy, attributes, activities, number of students, room specifics] and answers each one based on her class. If she is unclear about terminology, she can review the *Definition of Terms* section for clarification.

---

4. From that list she selects the top four attributes: ***explore, think, reflect and question***; pedagogy is ***blended learning*** and the main activities as: *active, passive and communication.*

5. Based on a highly informative professional development session given at the school when the tool was introduced, definitions and examples on the Learning Settings website, she is able to feel comfortable with her responses.

6. She is prompted to *generate layout typology;* layouts are generated based on the criteria input. Her answers result in three layout typologies, *community hub, focus lab and huddle pod.*

7. She selects the one that best suits the existing furniture in her room – *Huddle Pod* – and read the corresponding information and suggestions to begin from the list provided. She selects the *images* sections and looks at a collection of successful Huddle Pod layouts and photographs of actual classrooms posted by teachers to the forum. The tool generates a list of furniture and equipment that is suggested for this layout, and cross-references it with catalogue numbers should the opportunity to purchase new furniture be viable.

8. With minor work, she is confident that she will be able to implement a version of the Huddle Pod in her room. The plan indicates that, in addition to tables and chairs [which she has], moveable whiteboards or smart boards and a projector are recommended. She does not have these in her class, but knows that there is some money in the budget from fundraising efforts. She adds a list of fixtures and furniture she no longer needs to the school's 'free cycle' resource network – a forum for giving, getting and sharing materials, furniture, fixtures, accessories and technology.

9. Ms. McKinnon is happy with the results and looks forward to reconfiguring the room to reflect the suggestion from the *Learning Settings* tool. Additional information about decorative elements to incorporate is also included, and she is excited to engage her students in this activity, giving them a sense of responsibility and ownership of the environment.

User Feedback

Ms. McKinnon filled in the feedback section, indicating that the on-line Learning Settings Tool:

- was easy to use and very intuitive
- required no guesswork
- was convenient – she completed hers on the streetcar on her way home
- was enjoyable
- gave her confidence that she did not have before when approaching this problem on her own.
- was probably the most cost effective solution for the school board.

She suggested a *consult line* in case there were more complex situations or questions that needed expert advice. She was very satisfied with the results and posted her thoughts and photos on the experience to the school Facebook page and in the gallery section of the Learning Settings website to share with her colleagues.

Ms. McKinnon discovered that the on-line tool was far more social than she might have expected, and created a sense of community with other schools and teachers. They have started a *meet-up* where they get together in the real world to discuss ongoing ideas, issues, discoveries, successes and failures with each other.

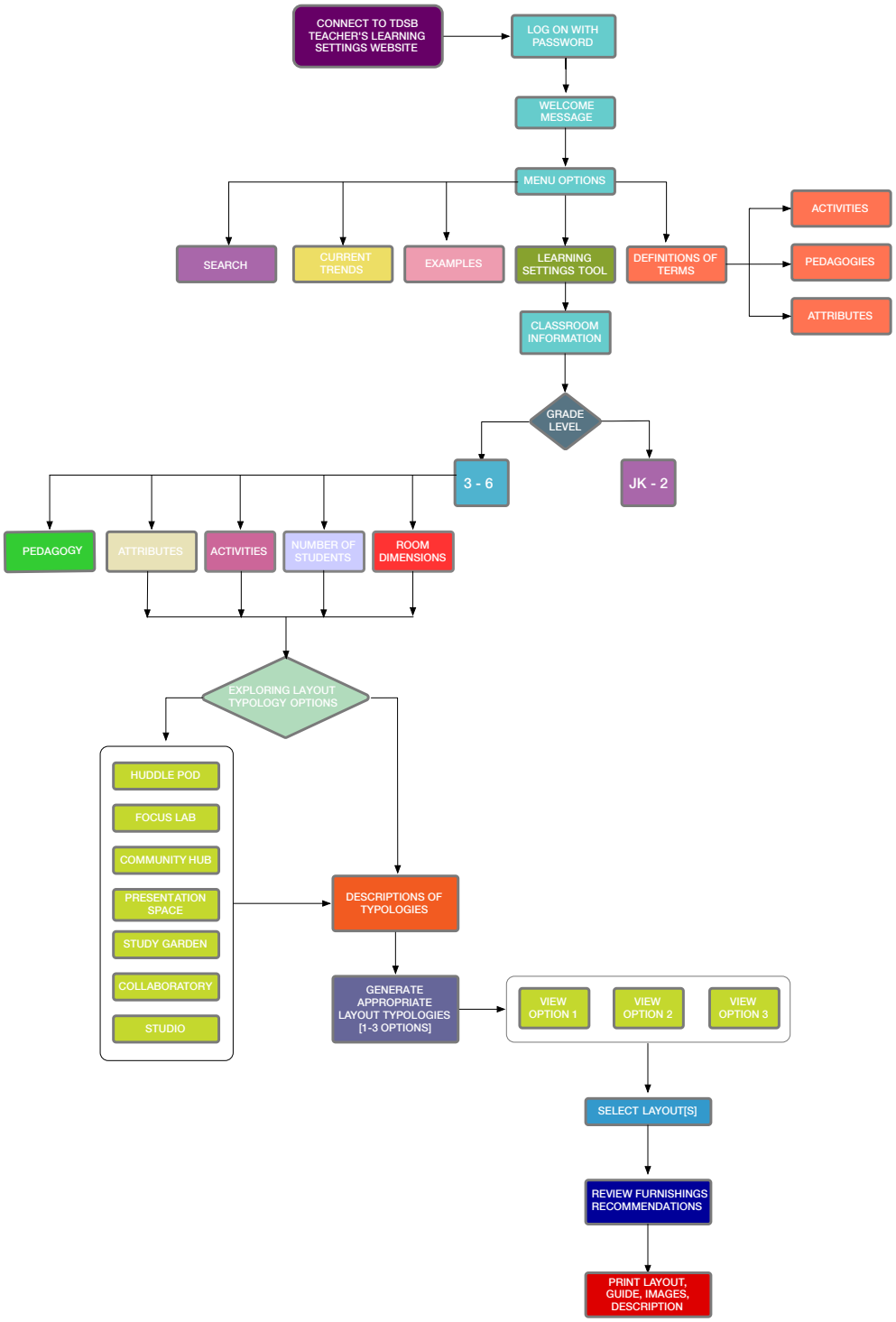


Figure 8: Learning Settings Design On-Line Tool

5.0 CONCLUDING THOUGHTS

As discovered, there is not one typical classroom; some may have four walls and a door, and others may be in the form of a computer screen, or even an outdoor space. In examining physical learning spaces, it can be concluded that the most significant criteria is that they be designed to be highly flexible and adaptable, encourage collaboration and creativity, and foster critical thinking. A successful tool should motivate the user to restructure the learning space in accordance with the learner's needs.

Functionality entails flexible and mobile learning spaces, furniture, and technology that enable users to easily change between learning spaces according to their learning goals and needs, individual, small group, or whole-class activities and even outside of-the-whole-class activities. The on-line tool introduced in this paper is a *bottom up* approach; participation in relation to school building design adds enormous value.

One researcher (Clark, 2002) sums this up when she says:

> *'The benefits of authentic participation include the emergence of better decisions and more appropriate solutions through the harnessing of stakeholders' knowledge of their surroundings.'*

Through engaging, enabling and empowering the key stakeholders (in this case the teachers), we may get there faster than we think.

> *"Finally, architects and others involved in the planning and design of school buildings do not create learning environments. Teachers create learning environments. School planners are responsible for providing a space from which teachers can create effective and efficient workspaces and learning environments." (Bissel, 2004)*

We are working within a system designed in the 19th century. Yes, it evolved to a certain extent in the 20th century, but that system is no longer capable of meeting the demands of

modern society. Schools are not fitting the rapidly changing world around us, and the digital natives are restless.

5.1 Further Research

This paper is just the beginning. The Learning Settings Tool, one small step. There were significant insights that resulted through research and the design of the Learning Settings Tool; possibly the most significant is that indeed space impacts our children and teachers. Additionally, further study is required in the area of physical learning design for K-6, and implementing 21st century attributes. It is my intention to introduce the Tool to a small number of teachers, based on response, feedback and their input, potentially present it to the Toronto District School Board for further development and research.

Collaboration with furniture systems companies with a focus on systems designed specifically for this age group, and to their styles of learning, would advance learning spaces greatly. Furniture children can easily move and reconfigure, serves multiple purposes and promotes flexibility is needed. Significant advancements in post-secondary learning spaces and furniture have been made; however, it seems our youngest members of society are being left out, and it is time to focus some of that energy and research on them. K-6 environments are more varied, must be more things to more people and the current approach is not meeting these needs.

It is hoped that the proposed The Learning Settings Tool will continue a conversation, and be the springboard for further development and research into, not just the issues related to learning environments, but to solutions to further develop systems and tools that will give 21st century children the best possible start.

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